"Evaluation of the current residential projects in Tier-II cities for replacing them with the Green residential projects: A Case study"

A Synopsis Submitted to

Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Towards the partial fulfillment for the award of

DOCTOR OF PHILOSOPHY

IN

CIVIL ENGINEERING

By

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Under the Guidance of

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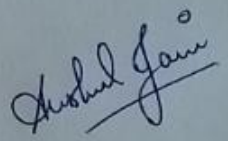
DECLARATION

I, Anshul Jain registered as a research scholar (Registration No. 2205PHDCE10533) in Shri Vaishnav Institute of Technology and Science, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore, do hereby declare that this synopsis is submitted in the partial fulfilment for the award of the degree of Doctor of Philosophy in Civil Engineering as prescribed by the university.

I hereby declare that work which is being presented in the Dissertation entitled ***"Evaluation of the current residential projects in Tier-II cities for replacing them with the Green residential projects: A Case study"*** is the outcome of independent investigation/research carried out by me. This work has not been submitted to any other University or body in quest of a degree, diploma or any other kind of academic award.

I also declare that the text, diagrams, or any other material taken from other sources (including but not limited to books, journals and websites) have been acknowledged, referred and cited to the best of my knowledge and understanding.



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SHRI VAISHNAV INSTITUTE OF TECHNOLOGY AND SCIENCE

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE

CERTIFICATE

This is to certify that the dissertation entitled "**Evaluation of the current residential projects in Tier-II cities for replacing them with the Green residential projects: A Case study**" has been written by Anshul Jain (2205PHDCE10533) under my supervision and guidance. The synopsis is his original work completed after careful research and investigation. The standard of the work is as expected from a candidate for the course work of Ph.D. degree. I recommend that the synopsis must be sent for evaluation.

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Forwarded by:

Head of the Institution

Dean

Faculty of Doctoral Studies and Research

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Anshul Jain
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Chapter-1

Introduction

Looking to the present scenario of rapid urbanisation, it is rather necessary to build up the infrastructures in almost all the villages, towns, or megacities. A person always demands a home as a necessity so is the result that we are continuously constructing residential projects everywhere. The main problems are arising due to the fact that the buildings consume about 40% of the energy. Approximately 43% of the worlds water utilisation and nearly half of the raw materials are consumed by buildings including the infrastructure construction, maintenance period. Simultaneously the major contributor of the air pollution in terms of green house gases and water pollution is the construction sector.

As the pollution is increasing tremendously in India, due to residential and commercial space requirements it is equivalently important to make sustainable development of prime importance. For all the residents water supply becomes an important problem and in the near future around 2030's fresh water supply will become a major issue. Currently the population has already crossed 142 crores in number and to supply them with living space, fresh water and pollution free environment seems to be impossible without the construction of Green buildings which can manage these issues easily.

According to the statements of CPCB It will cost less to construct green buildings then to make arrangements for purifying the waste water in the tier I and tier II cities. Along with it, green buildings will also provide far better living conditions to the residents of the country. The only issue is to reduce the benefits of these green infrastructures at a minimum cost.

Objectives of the Research

1) To eliminate the dependency on non renewable resources and ultimately reutilising the renewable resources in the construction industry to protect the environment from losses.
2) To optimize the use of advanced construction materials and advanced techniques by utilising minimum energy in the project and using the equipments which can satisfy the lighting, air conditioning, and other needs.
3) To make best use of the water and waste water treatment activities for providing safe and eco friendly conditions.
4) To commence government in making regulatory norms which can promote the construction of green buildings by providing subsidies and aids in the near future to the developers and customers in state as well as country.

Chapter-2

Review of Literature

2.1. Green Building

Green building is the way of developing structures that are environment friendly and resource-efficient throughout the building's life-cycle from site selection to deconstruction.

2.2. The Need for Green Building

Construction industry is the largest polluting and natural resources consuming sector in the world (Levine et. al., 2007; Plank, 2008). Thus infrastructure development is simultaneously responsible for the green house gas emission (Yi-Kai, et. al., 2010). The main reason of global warming is connected to the climate change issues and thus for the future generation, serious actions needs to be taken. (Taleb and Sharples, 2011). According to the United Nations Environmental programs if buildings are constructed as per the standard norms then environmental pollution can be minimized. They can save the energy, and minimize the generation of waste and conserve the mother nature.

The think tank behind the green building infrastructures is not only limited to Architects, but also to the designers, consultants and Engineers working together for the same goals related to planning, designing, construction, and operation. This team looks after the impacts which are negative in nature and trying to influence the positive approaches of the project.

Following aspects of a green building design are looked in a prime way.

1 Selection of a suitable site.

2 Designing part of infrastructures.

3 Design systems of HVAC [heating ventilation and air conditioning], lighting, electrical, and water heating)

4 Accessing the renewable energy sources to generate energy on-site

6 Managing the Water and generated waste management tools.

6 Selecting the advanced and sustainable materials which can be easily recycled.

2.3. Green Building Movement in India

The green buildings concept initiated in the year 2001 in India, then the Indian Green Building Council (IGBC) was formed as a part of the Confederation of Indian Industry (CII) with a vision "To enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025".

The IGBC helps in

1. Development of the Green rating standards and programmes.
2. Providing the training certificates.
3. Organising annual events for promoting green buildings.
4. It works in association with various government bodies and World Green Building Council.

India has performed well so far in terms of adopting the Green building movement but looking to the vast population and consequent infrastructure requirement, this pace needs to be further accelerated. The coverage of the Green building in terms of area was around 1.80 billion square feets till the year 2013 and it is expected that it will reach upto 20 billion square feets by the year 2025. (IBEF)

The classification of the buildings is as per the certifications provided by the concerned body. Various countries have designed their own certification programs for green infrastructures. Some of the popular ones are as following

1. The Building Research Establishment Environmental assessment Methodology (BREEAM), United Kingdom, 1990
2. Leadership in Energy and Environmental Design (LEED),theUnitedStates,1994
3. The Deutsche Gesellschaft für nachhaltiges Bauen (DGNB) system in Germany
4. Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan
5. The Green Star system in Australia.

Although Indians have shown a good progress in adopting the green initiatives in infrastructure but there isn't any kind of rule or compulsion to adopt these measures, due to which most of the people ignore this technique of construction. Yes the green buildings are costlier than the conventional ones due to which its demand is not arising at a tremendous pace. Never the less the damages associated with the mother nature due to the construction activities cannot be ignored. Thus government and concerned bodies shall try their best to make the citizens aware about the importance of these green infrastructures. Also the target drivers who can purchase the green buildings shall be highlighted.

2.4. Desire for Green Building Purchase

It is but obvious that the green infrastructures will come at a cost hence researches are going on to determine those factors which can increase their demand in the market. Amongst the major factors, environmental concern seems to be the most valuable one because every citizen

desires to protect the mother nature even at a due cost. The extra cost inculcated by the green projects can be compensated in the future because these infrastructures operates at a lower cost.

There are short term and long term benefits of the project. In terms of long term benefit the health of the residents remains far better than the occupants of a traditional building. Thus it can become a motivating scenerio for the purchasers. Along with it the geography of the area, cultural and the political aspects can further try to influence the demand for green buildings. (Salvi Marco, SyzJuerg,2011).

2.5. Drivers for Green Building Purchase

The researchers have tried to highlight some of the important criteria's for purchasing the green buildings.

Income: These green infrastructures are obviously a premium product in the market hence cost is going to be more but it will have a positive impact amongst the literate class of people.

Cultural Norms: The cultural norms will have a positive impact on the purchasing of these premium products as the probability to purchase varies across different regions.

Geography: As per the geographical conditions and nature of people residing in different locations, the concerns to purchase green building varies significantly. Thus research are being carried out to highlight the purchasing demands of different locations across the country.

Government Subsidies: Government is continuously taking a step forward to provide benefits to the purchasers of green infrastructures in the form of subsidies and relkaxation in the property taxes etc. This criteria thus have an positive impact on the promotion of green buildings and attracting the clients for these products.

Environmental Concern: The environmental issues are the ones which directly attacks the heart of literate ones and hence they are well versed to think about the alternative solutions for the same. The love for nature is reflected back in terms of a movement that we will purchase only the green buildings. Even these people are willing to purchase the costly products also for the sake of nature. (Kotchen and Moore, 2007, 2008; Kahn and Vaughn, 2009).

Environmental Knowledge: It is the knowledge which is an essential tool for the citizens of such a vast population so that the alternatives of protecting the nature can be researched and solutions may be promoted amongst the other citizens of the society.

The Proposed Model

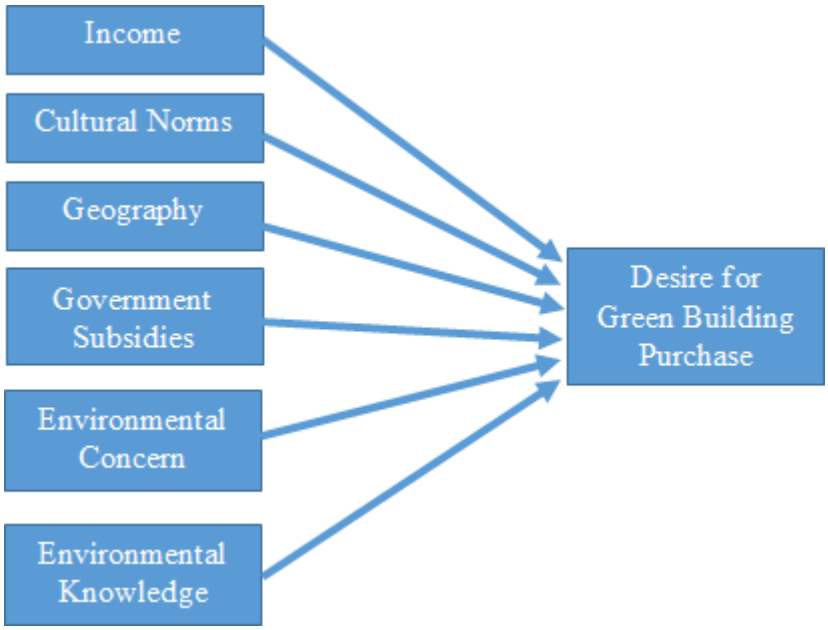

Figure 1 Drivers of Green Building Purchase

Adoption of Green Building guidelines in developing countries based on US and India experiences

For the sake of sustainable construction most of the developing and developed nations are trying to build guidelines for the construction of green buildings or are following the guidelines specified in their standard codes already built. All the need is to work for the implementation of these guidelines as early as possible in the near future. The formulation of green buildings standards for any country is based on the information gathered from the other countries manual and their past experiences. This way a country can accelerate the growth of green infrastructure and can contribute hand to hand in saving the environment globally. (Journal of Green Building, 2009)

Green Building Construction for Sustainable Future.

Looking to the devastating effects of global warming, the phenomenon of green buildings got a tremendous popularity as sustainable development is the only solution one can adopt. Indian democratic system too was influenced by these concerns as our economy was also progressing at a good rate about 7% annually and it was directly proportional to the infrastructural development. This paper has thus presented a clear picture as to why the adoption of green building rating systems are essential to be adopted if we need to go further with sustainable development. It has also discussed about the design strategies and how to make citizens aware about the sustainable infrastructures development. Thus the need of green buildings arised. (July 2013)

Environment sustainability guidelines for Green Buildings in India

The impact of real estate on the environment can never be neglected because the infrastructural development is consuming around 43% of energy, about 32% of the raw supplied material and about 25% of the land space of the cities. In return we are also generating around 35% of the solid waste materials and they are finally discharged in the cities leading to the environmental issues. The reason behind this is the absorption of energy throughout the service life of the buildings, thus generating the green house gases.

Then why not to adopt the principles of reducing the wastes, reusing the resources and recycling the generated wastes for improving the economy of the nation.

The development of Indian Green Building Council (IGBC) and Green Rating Integrated Habitat Assessment (GRIHA) by The Energy and Resources Institute (TERI) have tried to improvise the rating system for the entire country so that the green infrastructures can be evaluated easily. The major issue in front of the vision is the lack of awareness amongst the developers, colonisers and clients willing to invest or purchase the property. This has been excellently covered in this research article. Data have also been tried to be obtained from the various secondary sources to provide the key suggestions for developing sustainable construction techniques whether for urban or rural areas. (2016)

Green Building Requirement in India and Factors driving green building purchase

The environmental degradation has been witnessing the stage where it cannot heal by its own efforts rather the hardwork and positive approach by each and every citizen can bring changes. Thus the construction industry shall also try its best to mitigate the impacts caused over the natural surrounding and checking the impacts at every stage. The only way to minimise the impacts is the adoption of green building technologies. Thus everyone must be made aware to follow the guidelines decided by the green rating bodies and make a healthy change.

The authors here tried to highlight the mportance of green buildings with due considerations to the Indian context and how the demand for these green infrastructures can be brought amogst the stakeholders. Researches have been done over the cities of Shillong and Meghalaya where in the cost associated factor was the major obstacle in the demand for green buildings. People wish to receive aids from government in the form of subsidies on the purchase of green infrastructures.

Besides that people are well aware about the environmental knowledge and and factors responsible for pollution. Another case study of Pune city has been highlighted wher people are well affected by the reckless felling of trees and rapid urbanisation leading to losses in the form of environmental pollution. The concrete jungle being constructed every day is bringing the water table to the lowest level. The research study states that people are willing to buy green apartments in the campuses if government can bring some aid in the form of reducing prices or making the campuses maintenance charges free. (2017)

Impact of green production and green technology on sustainability: Cases on companies in India

This research work has determined the effects of green technologies over the Indian MNC are who are continuously involved in research and development in terms of production design and maintenance. Some of the MNC's selected for the research work were L&T, Tata Consultancy Services, Tech Mahindra etc. These brands have been listed already in the Climate Disclosure Leadership Index. All these companies have done a great work in the Green production technologies which is the main focussing point of this research work. These companies have a tremendous combination of technology, innovation and sustainable mindset which have made them the global leaders of their own fields. (2017)

Green Building in India: A Comparative and Spatial analysis of the LEED-India & GRIHA Rating System.

Indian population which is now the largest in number has two popular systems in existence, Leadership in Energy & Environmental Design (LEED) and GRIHA (Green Rating for Integrated Habitat Assessment) developed by the Ministry of new and renewable energy (MNRE) and The Energy & Resource Institute (TERI) This research paper has focussed on the overviews of both the systems highlighting their significance and ways of promoting sustainable construction work. (2015)

Chapter-3

Research Methodology

If along with the development, our environment is getting effected on a serious note, then it is quite an alarming situation. Some of the serious consequences are depletion in the ground water table, rapid growth in the average temperature, increase in the carbon footprints, unavailability of fresh air and water, excessive use of groundwater and tremendous growth in electricity consumption.

So looking to a long list of problems, there is a solution that why not to think of the ideas which can bring these problems to a standstill without affecting the growth and development. With the application of current technologies and better utilisation of the naturally available resources, we can prevent and mitigate our environment to the best possible extent. One of the way is to adopt the "Green Building Technology" concept which allows us to reduce the ill effects of the construction activities.

The basic objective of this technology is to take care of the environment and simultaneously leading to development in a very sustainable manner. One of the specified ways of adopting this concept in the construction activity is to follow the guidelines specified in "Green Rating Integrated Habitat Assessment (GRIHA)" It is actually a tool to analyse the project and evaluate it on the basis of pre-defined parameters and points, whether the ongoing project satisfies the essential and described criteria. Before understanding the need of this study, it is equally important to know the problem in the present scenario.

The real estate developers are not aware about the benefits of green building projects. They try to gain the maximum benefit/ profits and thus do not want to spend anything extra. But they do not consider the long-term benefits of these green buildings. If on adopting some of the criteria of GRIHA on the construction site, they can get ratings either from 1 to 5. This evaluation tool gives marking on the basis of pre-defined 33 criteria's and 4 marks are additionally provided if there are some innovative ideas being implemented on the site.

So the basis of this research model is to analyize the residential projects of Tier-II cities like Bhopal and bring the conclusion that what are the obstructions in building the green projects and what are the ways by which we can make people aware about the importance of green buildings and ultimately to start working on green residential projects in the near future by

the help of government aids. The ongoing selected projects in various locations of Bhopal will be analyzed throughout the different phases of the construction tenure.

Proposed stages of implementation for the research work.

1. In the initial stage, several residential projects which are going to start or have just started in different locations of Bhopal will be highlighted.
2. Based on the different locations, a few of the projects will be selected for evaluation purposes.
3. The selected projects will be evaluated based on the preconstruction phase, during construction phase and post construction phases.
4. The evaluation work will be done as per the 34 criteria's specified in the guidelines of GRIHA.
5. In common, the scores of all the selected projects of different locations will be evaluated and verified taking the help of a certified GRIHA professional.
6. Based on the scores obtained by different projects, the short comings to achieve at least 1 star rating as per GRIHA will be highlighted.
7. To overcome those shortcomings, suggestive construction or design changes will be suggested to the colonisers along with the expenditure to be incurred.
8. This detailed analysis will present a clear picture in front of the coloniser that on taking care of the suggested points, their future projects can be converted to Green residential projects which will be unique for the customers as well.
9. Simultaneously the compiled reports of various residential projects across Bhopal can be presented before the government bodies for providing suitable aid in the form of appreciation to the customers and colonisers.

The details of all the 34 criteria for evaluation purposes has been highlighted here.

GRIHA Evaluation Process

According to the GRIHA evaluation system, the buildings are evaluated as per the three tier process. GRIHA first of all checks whether the mandatory criteria's have been covered else the project is rejected in case of non-compliance with such criteria. After this stage the documents submitted are verified for the optional criteria's.

The checking is done by the team members of GRIHA to make sure that all templates and drawings have been filled up and to ensure that the documentation shall be finalized in all respects (for the attempted criteria). All documents shall be checked and vetted through the

appraisal process which has been specified by GRIHA. The GRIHA team collects the first evaluation report and informs the concerned client. The client is allowed to resubmit details as requested by the Secretariat in the first evaluation report.

The documentation is finally sent to the GRIHA evaluators consisting of the following resources.

1. Renowned sector experts from landscape architecture.
2. Lighting and HVAC design.
3. Renewable energy, water and waste management, and building materials.

The evaluation report shall be sent to the project proponent to review the same and, the chances are provided to further increase their project score. The report shall elaborate on the results of the evaluation committee along with its comments. The report shall specify and list the criteria for which the documentation needs changes or is not up to the mark, detailing all the required information. The client receives a month long time to resubmit the document with necessary modifications. The evaluation committee finally awards the score, which shall be presented to an advisory committee comprising of eminent personalities and renowned professionals in the field for approval and award of rating. The rating remains valid for a period of five years from the date of commissioning of the building.

The evaluation of any project is done based on the following criteria's

	Evaluation system of GRIHA criteria		
S.no	Description	Points	
Criterion 1	Site Selection	1	Partly mandatory
Criterion 2	Preserve and protect landscape during construction/compensatory depository forestation.	5	Partly mandatory, if applicable
Criterion 3	Soil conservation (post construction)	2	
Criterion 4	Design to include existing site features	4	
Criterion 5	Reduce hard paving on site	2	Partly mandatory
Criterion 6	Enhance outdoor lighting system efficiency	3	
Criterion 7	Plan utilities efficiently and optimize on-site circulation efficiency	3	
Criterion 8	Provide, at least, minimum level of sanitation/safety facilities for construction workers	2	Mandatory
Criterion 9	Reduce air pollution during construction	2	Mandatory
Criterion 10	Reduce landscape water requirement	3	
Criterion 11	Reduce building water use	2	
Criterion 12	Efficient water use during construction	1	

Criterion 13	Optimize building design to reduce conventional energy demand	8	Mandatory
Criterion 14	Optimize energy performance of building within specified comfort Limits	16	Partly mandatory
Criterion 15	Utilization of fly-ash in building structure	6	
Criterion 16	Reduce volume, weight, and time of construction by adopting efficient technology for example, pre-cast systems, ready-mix concrete, and so on)	4	
Criterion 17	Use low-energy material in interiors	4	
Criterion 18	Renewable energy utilization	5	Partly mandatory
Criterion 19	Renewable energy based hot- water system	3	
Criterion 20	Waste water treatment	2	
Criterion 21	Water recycle and reuse (including rainwater)	5	
Criterion 22	Reduction in waste during construction	1	
Criterion 23	Efficient waste segregation	1	
Criterion 24	Storage and disposal of wastes	1	
Criterion 25	Resource recovery from waste	2	
Criterion 26	Use of low VOC paints/adhesives/sealants	3	
Criterion 27	Minimize ozone depleting substances	1	Mandatory
Criterion 28	ensure water quality	2	Mandatory
Criterion 29	acceptable outdoor and indoor noise levels	2	
Criterion 30	tobacco and smoke control	1	Mandatory
Criterion 31	Universal accessibility	1	
Criterion 32	energy audit and validation		Mandatory
Criterion 33	Operations and maintenance protocol for electrical and mechanical equipment	2	Mandatory
Criterion 34	Innovation (beyond 100)	4	
		104	

Chapter-4

Expected Outcomes

All we need to do is to collect the data of the activities being done as per the specified 34 criteria's during construction phase and completion phase of the project. On submitting the report, we can be awarded with star ratings for our project from 1 to 5. Some of the builders do follow some of the criteria's which are already a part of GRIHA evaluation system but they are unaware to apply for green ratings. So the outcome of this research proposal is to

1. Undergo the analysis of the construction projects in Bhopal, to evaluate them and make sure that they follow some of the criteria's including the compulsory ones, so that at least 1 star rating can be achieved.
2. The customers on the other hand will be benefitted throughout the service life of the infrastructure they have purchased, which will save a huge amount which was supposed to be spent on water, electricity and other energy sources.
3. Simultaneously the losses of the environment will also be reduced. Example on adopting the rain water harvesting technique in the project, water supply of a good duration can be done through rain water itself.
4. Similarly, use of natural sunlight and ventilation can minimize the electricity bills up to 60%.
5. The health of the labours and safety parameters can be enhanced for better living standards.
6. On studying the residential projects in Bhopal we can identify what criteria's can be further covered by the colonisers so that they may get star ratings for their projects. This will directly help in protecting the mother nature as well.
7. Thus, this research work can bring awareness amongst the real estate developers and society members, so that green building technology can be adopted widely in our cities across the country.

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